[marginalia] *by Sept. 1*

(19) Patent Office of Japan (12) Publication of Unexamined Patent Application (A)
(11) Unexamined Patent Application Publication - H11-3039
(43) Publication Date: January 6, 1999

Int. Cl[6]			ID Symbol	FI	
G 09 F	9/00	337		G 09 F 9/00	337B

Examination Request: Not Requested No. of Claims: 6 OL (Total 7 pages)

(21) Patent Application No.: H9-151847

(22) Patent Application Date: June 10, 1997

(71) Applicant: 000136136
P.F.U. Co., Ltd.
Nu 98-2, Aza Unoke, Unoke-machi
Kahoku-gun, Ishikawa

(72) Inventor: Masaki UTSUNOMIYA
c/o P.F.U. Co., Ltd.
Nu 98-2, Aza Unoke, Unoke-machi
Kahoku-gun, Ishikawa

(72) Inventor: Katsuo TANAKA
c/o P.F.U. Co., Ltd.
Nu 98-2, Aza Unoke, Unoke-machi
Kahoku-gun, Ishikawa

(73) Representative: Morihiro OKADA, Attorney

continued on last page

(54) Title of Invention:

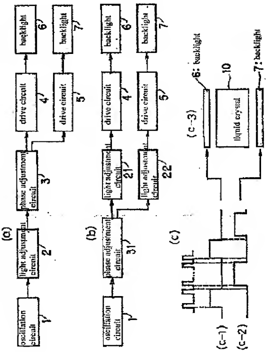
LCD Backlight Lighting Circuit

(57) Abstract:

Problem to be Solved: The present invention pertains to an LCD backlight lighting circuit, with the objective of eliminating flicker by alternately lighting a plurality of backlights and eliminating flicker caused by interference with a frame frequency by lighting a backlight in synchronization with the frame frequency.

Means to Resolve the Problem: Configure so as to be provided with an oscillation circuit that oscillates a signal for lighting a backlight, a light adjustment circuit that generates a signal of specified duty that lights the backlight based on the signal oscillated by the oscillation circuit, a phase adjustment circuit that shifts the phase of the signal of specified duty generated by the light adjustment circuit, and a drive circuit that lights a first backlight according to a signal that has not been shifted by the phase adjustment circuit and lights a second backlight according to a signal that has been shifted by the phase adjustment circuit.

Block Diagram of the System of the Present Invention



(Scope of Patent Claims)

(Claim 1) With respect to a lighting circuit that lights an LCD backlight, an LCD backlight lighting circuit characterized by being provided with an oscillation circuit that oscillates a signal for lighting a backlight, a light adjustment circuit that generates a signal of specified duty that lights the backlight based on the signal oscillated by the oscillation circuit, a phase adjustment circuit that shifts the phase of the signal of specified duty generated by the light adjustment circuit, and a drive circuit that lights a first backlight according to a signal that has not been shifted by the phase adjustment circuit and lights a second backlight according to a signal that has been shifted by the phase adjustment circuit.

(Claim 2) With respect to a lighting circuit that lights an LCD backlight, an LCD backlight lighting circuit characterized by being provided with an oscillation circuit that oscillates a signal for lighting a backlight, a phase adjustment circuit that shifts the phase of the signal oscillated by the oscillation circuit, a light adjustment circuit that generates a signal of specified duty based on a signal that has not been shifted by the phase adjustment circuit and generates a signal of specified duty based on a signal that has been shifted by the phase adjustment circuit, and a drive circuit that lights a first backlight according to the signal of specified duty that was generated based on the above non-phase-shifted signal and lights a second backlight according to the signal of specified duty that was generated based on the above phase-shifted signal.

(Claim 3) With respect to a lighting circuit that lights an LCD backlight, an LCD backlight lighting circuit characterized by being provided with a VCO circuit that oscillates a signal of specified frequency that lights a backlight based on a frame signal provided to a liquid crystal display unit, and a drive circuit that drives a backlight with a signal of specified duty based on the signal oscillated by the VCO circuit.

(Claim 4) With respect to a lighting circuit that lights an LCD backlight, an LCD backlight lighting circuit characterized by being provided with a VCO circuit that oscillates a signal of specified frequency that lights a backlight based on a control input signal; a divider circuit that divides the frequency of the signal output by the VCO circuit into a signal corresponding to a frame signal; a circuit that compares the signal from the divider circuit corresponding to a frame signal, and the frame signal provided to the liquid crystal display unit, generates a frequency and phase error signal, and inputs said error signal to the VCO circuit as a control input signal; and a drive circuit that generates a signal of specified duty based on the signal oscillated by the VCO circuit and drives the backlight.

(Claim 5) An LCD backlight lighting circuit as described in Claim 1, characterized in that a signal oscillated by a VCO circuit described in Claims 3 or 4 is used as the signal oscillated by the oscillation circuit.

(Claim 6) An LCD backlight lighting circuit as described in Claim 2, characterized in that a signal oscillated by a VCO circuit described in Claims 3 or 4 is used as the signal oscillated by the oscillation circuit.

(Detailed Explanation of the Invention)

(0001) (Technical Field of the Invention) The present invention pertains to an LCD backlight lighting circuit that lights an LCD backlight.

(0002) (Prior Art) Conventionally, backlights for liquid crystal displays are normally lighted with a specified frequency, and text and images are displayed by means of the differences in partial transparency of the liquid crystals with regard to this illuminated light.

(0003) (Problem to be Solved by the Invention) At this time, when a backlight is operated and lighted with low-frequency signals of specified duty and text and images are displayed based on differences in the partial transparency of liquid crystals, problems such as the development of flicker as well as flicker caused by interference between the frame frequency of the liquid crystal display and the backlight lighting have occurred.

(0004) In order to solve this problem, the objective of the present invention is to eliminate flicker by alternately lighting a plurality of backlights and to eliminate flicker caused by interference with the frame frequency by lighting the backlight in synchronization with the frame frequency.

(0005) (Means to Solve the Problem) We will explain the means to solve the problem with reference to FIG. 1 and FIG. 2. In FIG. 1 and FIG. 2, the oscillation circuit 1 oscillates a signal of specified frequency that lights a backlight.

(0006) Light adjustment circuits 2, 21 and 22 generate signals of specified duty that light a backlight based on the signal oscillated by the oscillation circuit 1. Phase adjustment circuits 3 and 31 shift the phase of the signals of specified duty generated by the light adjustment circuits 2, 21 and 22.

(0007) Drive circuits 4, 5 and 14 light the backlight based on signals of specified duty. The VCO circuit 13 oscillates a signal synchronized with a frame signal.

(0008) Next, we will explain the operation. The oscillation circuit 1 oscillates a signal for lighting a backlight, the light adjustment circuit 2 generates a signal of specified duty that lights a backlight based on the signal oscillated by the oscillation circuit 1, the phase adjustment circuit 3 shifts the phase of the signal of specified duty generated by the light adjustment circuit 2, and drive circuits 4 and 5 light a first backlight 6 according to a signal that has not been

shifted by the phase adjustment circuit 3, and light a second backlight 7 according to a signal that has been shifted by the phase adjustment circuit 3.

(0009) Also, the oscillation circuit 1 oscillates a signal for lighting a backlight, the phase adjustment circuit 31 shifts the phase of the signal oscillated by the oscillation circuit 1, the light adjustment circuits 21 and 22 generate signals of specified duty based on unshifted signals and generate signals of specified duty based on shifted signals respectively from the phase adjustment circuit 31, and the drive circuits 4 and 5 light a first backlight 6 according to the signal of specified duty generated based on an unshifted signal and light a second backlight 7 according to the signal of specified duty generated based on a shifted signal.

(0010) Also, the VCO circuit 13 oscillates a signal for lighting a backlight based on a frame signal provided to a liquid crystal display unit, and the drive circuit 14 drives and lights a backlight with a signal of specified duty based on the signal oscillated by the VCO circuit 13.

(0011) Also, the VCO circuit 13 oscillates a signal corresponding to a control input signal; the divider circuit 17 divides a frame frequency signal from the signal output by the VCO 13; the synthesis circuit 16 compares the frame frequency signal from the divider circuit 17 with the frame signal delivered to the liquid crystal display, then generates a frequency and phase error signal and inputs [said signal into] the VCO circuit 13 as a control input signal, synchronizing it with the phase of the frame signal.

(0012) On these occasions, the drive circuit 14 generates a signal of specified duty based on the signal oscillated by the VCO circuit 13 and drives and lights the backlight.

(0013) Further, the signal oscillated by the VCO circuit 13 is used as the signal from the oscillation circuit 1. Consequently, it is possible to eliminate flicker by alternately lighting a plurality of backlights and to eliminate flicker caused by interference with the frame frequency by synchronizing with the frame frequency and then lighting.

(0014) (Embodiments of the Invention) Next, we will explain an embodiment of the present invention and its operation in detailed sequence, using FIG. 1 and FIG. 2.

(0015) FIG. 1 shows a block diagram of the system of the present invention. FIG. 1 (a) shows an example where the phase adjustment circuit 3 is provided following after the light adjustment circuit 2. In FIG. 1 (a) the oscillation circuit 1 is a circuit that oscillates a signal of specified frequency that lights backlights 6 and 7; for example, a circuit that generates a signal of specified frequency by dividing a signal oscillated by a liquid crystal oscillator.

(0016) The light adjustment circuit 2 generates a signal of specified duty for lighting backlights 6 and 7 based on the signal of specified frequency oscillated by the oscillator circuit 1 (refer to FIG. 1 (c)).

(0017) The phase adjustment circuit 3 shifts the phase of the signal generated by the light adjustment circuit 2, for example, shifting the phase by approximately 180° as shown in FIG. 1 (c-1) and (c-2).

(0018) Drive circuits 4 and 5 drive and light backlights 6 and 7 based on signals that were not phase-shifted and signals that were phase-shifted by the phase adjustment circuit 3 respectively.

(0019) Backlights 6 and 7 illuminate from the rear surface of liquid crystals not shown in the figure, in order to clearly display text and images corresponding to partial transparency and opacity of the liquid crystals.

(0020) Based on the above configuration, the light adjustment circuit 2 generates a signal of specified duty and specified frequency that operates backlights 6 and 7 based on the signal oscillated by the oscillation circuit 1; the phase adjustment circuit 3 shifts the phase of the generated specified-frequency, specified-duty signal by almost 180°; and drive circuits 4 and 5 drive and light the backlight 6 based on signals of specified frequency and duty that were not phase-shifted and drive and light the backlight 6 [sic] based on signals of specified frequency and duty that were phase-shifted. By this means, backlights 6 and 7 are alternately lighted and the number of lightings is approximately doubled, thus making it possible to eliminate flicker.

(0021) FIG. 1 (b) shows an example with two light adjustment circuits 21 and 22 provided following after the phase adjustment circuit 31. Here, the oscillation circuit 1, drive circuits 4 and 5 and backlights 6 and 7 are the same as in FIG. 1 (a), so we have abbreviated the explanation.

(0022) In FIG. 1 (b), the phase adjustment circuit 31 shifts the phase of a signal oscillated by the oscillation circuit 1, and the light adjustment circuits 21 and 22 generate signals for driving the backlights 6 and 7 whose phases differ by almost 180°.

(0023) The light adjustment circuits 21 and 22 generate signals of specified frequency and duty that alternately light (alternately light due to the almost 180° difference in phase) the backlights 6 and 7, based respectively on signals that have and have not been phase-shifted by the phase adjustment circuit 31.

(0024) Based on the above configuration, the phase adjustment circuit 31 shifts the phase of a signal based on the signal oscillated by the oscillation circuit 1; the light adjustment circuits 21 and 22 generate signals of specified frequency and duty that drive the backlights 6 and 7 based on signals that have not been phase-shifted, and generate signals of specified frequency and duty

with an almost 180° phase difference based on signals that have been phase-shifted; the drive circuits 4 and 5 drive and light the backlight 6 based on the generated signal of specified frequency and duty that has not been phase-shifted, and also drive and light the backlight 7 based on the generated signal of specified frequency and duty that has been phase-shifted. By this means, the backlights 6 and 7 are alternately lighted and the number of lightings is approximately doubled, thus making it possible to eliminate flicker.

(0025) FIG. 1 (c) shows an example of a lighting waveform. FIG. 1 (c-1) shows the signal for driving and lighting the backlight 6 that has not been phase-shifted. This driving and lighting signal is the signal input into the drive circuit 4 in FIG. 1 (a) and (b), and the drive circuit 4 drives and lights the backlight 6 based on this input signal shown in the figure.

(0026) FIG. 1 (c-2) shows the signal for driving and lighting the backlight 7 that has been phase-shifted. This driving and lighting signal is the signal input into the drive circuit 5 in FIG. 1 (a) and (b), and the drive circuit 5 drives and lights the backlight 7 based on this input signal shown in the figure.

(0027) By lighting the backlight 6 based on the driving and lighting signal in FIG. 1 (c-1) that has not been phase-shifted, and lighting the backlight 7 based on the driving and lighting signal in FIG. 1 (c-2) that has been phase-shifted, thus alternately lighting the backlights 6 and 7, illuminating from the rear surface of the liquid crystals 10 and displaying images and text corresponding to the partial transparency and opacity of the liquid crystals 10, the lighting frequency doubles and it is possible to eliminate flicker.

(0028) FIG. 2 shows another system block diagram of the present invention. FIG. 2 (a) shows an example of lighting the backlight 15 by generating a signal of specified frequency and duty that is synchronized with a frame signal by the VCO circuit 13.

(0029) In FIG. 2 (a), device 11 is something, for example, a personal computer that makes a liquid crystal display unit 12 display by inputting a frame signal. The liquid crystal display unit 12 drives the partial transparency and opacity of the liquid crystals based on the frame signal (or also by a synchronization signal not shown in the figure) and displays text and images by illumination from the backlight 15 from the rear surface.

(0030) The VCO circuit 13 oscillates a signal of specified frequency and duty that drives the backlight 15 in synchronization with the frame signal. The drive circuit 14 lights the backlight 15 based on the signal of specified frequency and duty from the VCO circuit 13. Here, to simplify the explanation, the drive circuit 14 and backlight 15 are described as one set, but, as shown in FIG. 1 described previously, it is also acceptable to make the drive circuit 14 and backlight 15 into two groups and light alternately.

(0031) Based on the above configuration, a signal of specified frequency and duty is oscillated in synchronization with the frame signal by the VCO circuit 13, and the drive 14 drives and lights the backlight 15 based on this signal of specified frequency and duty. By this means, the lighting of the backlight 15 is synchronized with the frame signal, making it possible to eliminate flicker caused by synchronization slip between the frame signal and the lighting of the backlight 15. Moreover, signals of specified frequency and duty with a phase shift of 180° are also generated by the VCO circuit 13, and two sets of drive circuits 14 are established, lighting one backlight 15 with the signal of specified frequency and duty that has no phase slip and lighting another backlight 15 with the signal of specified frequency and duty whose phase has slipped 180°, doubling the repeated lightings and making it possible to further eliminate flicker.

(0032) FIG. 2 (b) shows an example where a signal of specified frequency and duty that is synchronized with the frame signal is generated and a signal equivalent to a divided frame signal is generated by the VCO circuit 13 and synthesized by the synthesis circuit 16; that error signal is fed back to the VCO 13 to match the frequency and phase with greater accuracy to the frame signal, after which the backlight 15 is lit. Here, the device 11, liquid crystal display unit 12, drive circuit 14 and backlight 15 are the same as in FIG. 2 (a) so we have abbreviated the explanation.

(0033) In FIG. 2 (b), the VCO circuit 13 oscillates, in synchronization with a frame signal, a signal of specified frequency and duty that drives the backlight 15, and then, the output signal is divided by the divider circuit 17, generating a signal equivalent to a frame signal; the error between this generated signal and the frame signal is generated by the synthesis circuit 16 and input, forming a feedback group to accurately match the frequency and phase with the frame signal.

(0034) The synthesis circuit 16 generates the error (frequency and phase error) between the frame signal, which is the reference, and the signal equivalent to a frame signal divided by the divider circuit 17 from the signal oscillated by the VCO circuit 13 and then inputs it to the VCO circuit 13.

(0035) The divider circuit 17 divides the signal output by the VCO circuit 13 and generates a signal equivalent to a frame signal. Based on the above configuration, along with oscillating a signal of specified frequency and duty by the VCO circuit 13, a signal equivalent to a frame signal is generated by the divider 17 by dividing the output signal from the VCO circuit 13, an error

(frequency and phase error) between the reference frame signal and the signal equivalent to a frame signal divided by the divider circuit 17 is generated by the synthesis circuit 16, this error signal is input in the form of feedback to the VCO circuit 13, the frequency and phase of the signal of specified frequency and duty output by the VCO circuit 13 is completely fed back and matched to the frame signal, and the drive circuit 14 lights the backlight 15 based on this matched signal of specified frequency and duty. By this means, the lighting of the backlight 15 is completely synchronized to the frame signal, thus it is possible to prevent flicker caused by synchronization slip between the frame signal and the lighting of the backlight 15. Moreover, a signal of specified frequency and duty with a 180° phase slip is also generated by the VCO circuit 13, two sets of drive circuits 14 are established, one backlight 15 is lighted with a signal of specified frequency and duty that has no phase slip, and another backlight 15 is lighted with a signal of specified frequency and duration with a 180° phase slip, doubling the repeated lightings and making it possible to further eliminate flicker.

(0036) FIG. 2 (c) shows an example where the VCO output signal and the backlight lighting signal are synchronized. FIG. 2 (c-1) shows one screen of a frame signal. The frame signal is a signal that shows one frame operating a liquid crystal display unit 12.

(0037) FIG. 2 (c-2) shows a VCO output signal. The VCO output signal is the signal output by the VCO circuit 13 and is synchronized here with the frame signal in FIG. 2 (c-1). Note that the VCO output signal is a signal synchronized with the frame signal and of specified frequency and 50% duty. It is acceptable to light the backlight 15 with this signal as is, and it is also acceptable to light the backlight 15 with a signal where the 50% duty is adjusted at discretion. Moreover, although it is not shown in the drawing, it is acceptable to generate another set of signals with a 180° phase difference as in FIG. 1 (c-1) and (c-2), establish two sets of backlights 15 and light them alternately.

(0038) FIG. 2 (c-3) shows a backlight lighting signal. The backlight lighting signal is synchronized with the frame signal for one screen, thus there is no occurrence of flicker caused by slip between the frame signal and the backlight lighting (flicker caused by interference).

(0039) By means of generating the VCO output signal of FIG. 2 (c-2) in synchronization with the frame signal of FIG. 2 (c-1) above and driving the backlight 15 based on this synchronized VCO output signal, it is possible to eliminate the occurrence of flicker caused by synchronization slip between the partial transparency and opacity of the liquid crystals and the illumination from the rear of the liquid crystals from the backlight 15 (flicker caused by interference). Moreover, as explained in FIG. 1, it is also possible to eliminate flicker by providing two sets of backlights 15 and alternately lighting and doubling the repeating lighting cycle.

(0040) (Effect of the Invention) As explained above, by means of the present invention, flicker can be eliminated by alternately lighting a plurality of backlights and flicker caused by frequency interference between the frame frequency and the synchronized lighting can also be eliminated.

(Brief Explanation of the Figures)

(FIG. 1) Block diagram of a system of the present invention

(FIG. 2) Block diagram of another system of the present invention

(Explanation of Symbols)

1: Oscillation circuit
2, 21, 22: Light adjustment circuits
3, 31: Phase adjustment circuits
4, 5, 14: Drive circuits
6, 7, 15: Backlights
10: Liquid crystals
11: Device
12: Liquid crystal display unit
13: VCO circuit
16: Synthesis circuit
17: Divider circuit

FIG. 1

Block Diagram of a System of the Present Invention

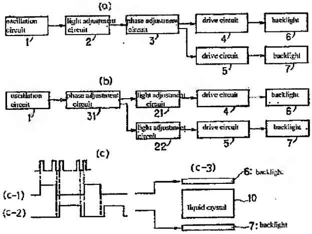
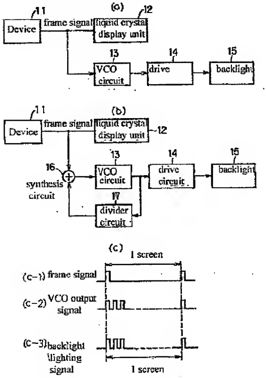


FIG. 2

Block Diagram of Another System of the Present Invention



Continued from front page

(72) Inventor: Yuji ISHIKAWA
c/o P.F.U. Co., Ltd.
Nu 98-2, Aza Unoke, Unoke-machi
Kahoku-gun, Ishikawa

(72) Inventor: Tadashi SATO
c/o P.F.U. Co., Ltd.
Nu 98-2, Aza Unoke, Unoke-machi
Kahoku-gun, Ishikawa

The LanguageWorks, Inc.
1123 Broadway
New York, NY 10010
Tel. 212 447 6060
Fax 212 447 6257

Language Works

STATE OF NEW YORK)
) ss
COUNTY OF NEW YORK)

CERTIFICATION

This is to certify that the attached, to the best of my knowledge and belief, is a true and accurate translation into English of "Patent 11-3039," completed 09/06/2005, originally written in Japanese.

Glenn Cain
Manager of Legal Translation Services
The LanguageWorks, Inc.

Sworn to and subscribed before me,
This Thirteenth day of June, 2006.

Kathleen Ames
Notary Public, State of NY
ID NO. 01AM6146595
Qualified in New York County
Commission Expires May 22, 2010